

See me: Adaptive rain kit for people who use a wheelchair for mobility assistance

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*Concept Statement:* Conspicuous and bold, *See Me: Adaptive Rain Kit*, is an adaptive rain vest, quarter-zip pullover, and technical legging designed to enhance the visibility and safety of the wearer while surpassing the technical innovation and aesthetics of existing adaptive outerwear. *See Me*, the title of this work, is a double entendre devised to have a literal meaning - catch one's attention for safety considerations, and the second meaning is an appeal to recognize that the person with the disability is, first and foremost, a person. As such, the purpose of this design is to embolden the wearer to unapologetically – to be seen – and provide weather protection and visibility in well-designed performance apparel that is as functional as it is eye-catching.

*Contextual Review, Significance, and Rationale:* The researcher defined the design's intended target market, product category, visibility, technical, and adaptive features based on a content analysis conducted from March to May 2021 of adaptive apparel products. The content analysis resulted in 2047 adaptive products across 39 adaptive brands. Within this data set, the researcher filtered the adaptive feature column of the data set to show only products coded as "weather protection," defined as garments developed to protect the wearer from wind, rain, and snow. This resulted in 108 products, which were reviewed for salient themes. The key observations from the content analysis were there *was an overall lack of adaptive outerwear - only 5% of the data set was outerwear, but outerwear is a significant need for people with disabilities* (Kabel et al., 2017). In addition, most of the products were made for cool or cold weather environments leaving a void for protection in the warmer seasons. Furthermore, there were limited options for women and juniors. Only 18% of the products were developed for women, and 92% of the products were designed for adults. All the adult products were seemingly aimed at a middle age demographic, leaving a large void for teens and young adults. Given this, the target market for this rainwear kit are young adults who identify as female and who use a wheelchair for mobility assistance.



Figure 1. Left: Initial technical illustrations in illustrator; Right: Development of zippers and reflective back logo.

No products included in this analysis had any visibility or safety features, such as reflectivity. People who use wheelchairs are at a substantially higher risk of pedestrian/driver accidents than people who do not use wheelchairs for mobility assistance (Kraemer & Benton, 2015). The mortality rate for people who use wheelchairs 36% higher than the overall population (Kraemer & Benton, 2015). Nearly half of all fatal accidents occurred in intersections, and among intersection crashes, 95% occurred when the person was in the crosswalk, indicating a lack of overall visibility of the pedestrian in the wheelchair by drivers. Given this, the designer aimed to develop a high-visibility garment to help the wearer be noticed on roadways, sidewalks, and other public spaces where safety is a consideration.

*Aesthetic and Functional Properties:* The researcher used the key findings from the content analysis to justify decisions in the current design. Regarding weather protection, the three garments have water-resistant features. The vest body, quarter-zip sleeves, and lap of the leggings are made of ripstop Supplex nylon with a DWR finish to ensure the garment is water-resistant. When worn with the vest, the sleeves of the quarter-zip provide rain protection, and when worn alone, the quarter-zip sleeves provide dirt protection with the DWR finish on the fabric. This fabric is also included on the wearer's lap of the leggings, to shed water from horizontal body surfaces.

In this design, there are two key components to enhance the visibility of the wearer - the fluorescent coral color and the use of retroreflective fabrics for low-light visibility. The researcher placed reflective elements in strategic areas on the garment, particularly the wearer's shoulders, and chest area, for a steady reference point. Reflective elements are also included on the arms and wrists for a flicker of reflection to catch the eye. Together these points alert a driver that there is a person in a wheelchair ahead. This combination of materials, color, and design help keep people who use wheelchairs safe. The design features eight bonded zipper pockets for water-resistant, secure storage that is accessible from a seated position. The zippers were created using Bemis adhesives and have a reflective boarder. Regarding adaptive features, all the patterns in this design were cut for a seated fit where the researcher extended the back rise of the leggings and lowered the front rise for a smooth, non-binding fit. The vest and quarter-zip were specially designed for wheelchair wear, with the back slightly longer than the front, which means that the garments drape well when sitting. Furthermore, all garments have accessible dressing features such as zippers to open narrow openings like the sleeves and neckline of the quarter-zip. The garment closures have custom 3D printed zipper pull, so if needed, the wearer can grip or loop their finger through the pull to help manipulate the garment closures.

*Process, Technique, and Execution:* The design process began by developing technical flats in Adobe Illustrator of the garments on a croquis in a seated position (Figure 1). The researcher developed patterns by hand using a basic block pattern adjusted to fit a seated mannequin. Ideally, the designer would have worked with a live fit model who had a mobility impairment. Without access to a fit model, the designer purchased a seated mannequin. Next, fit samples were developed to check fit and proportion. From there, the researcher prepared the trims by adhering Bemis adhesive film to the backside of reflective fabric, laser cut the reflective elements, including the bonded zipper outer layer, adhesives for the bonded zipper, and cutting out the holes in the garment patterns where the zippers would be placed. In parallel to this, the researcher also

3D printed the zipper pulls and created the custom zippers (cutting the bulk zipper tape to the correct length, adding the lime green cams, adding the zipper garages, and assembling the bonded zipper). Finally, the researcher assembled each garment using both Bemis sew-free technology and industrial sewing construction techniques.

*Contribution:* This design contributes to the advancement of adaptive outerwear options for people living with disabilities, by addressing both social and functional safety considerations. An implication of this work is a nuanced understanding of specific safety needs for people who use wheelchairs. This work shows that the same level of innovation, if not more, can be applied for adaptive outerwear as non-adaptive outerwear, thereby ensuring that everyone has access to performance apparel – and style - desired by all consumers.

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#### References

Kraemer, J. D., & Benton, C. S. (2015). Disparities in road crash mortality among pedestrians using wheelchairs in the USA: results of a capture-recapture analysis. *BMJ Open*, 5(11).

Kabel, A., Dimka, J., & McBee-Black, K. (2017). Clothing-related barriers experienced by people with mobility disabilities and impairments. *Applied Ergonomics*, 59, 165-169.

